REMARKS

Claim 27 has been canceled and new claims 34 and 35 have been added. No new matter was added. Thus, claims 1, 28 and 30-35 are pending. For reasons stated below in detail, Applicant respectfully submits that the claims of the present application are patentable over the prior art of record and that the present application is in condition for allowance.

I. Claim Rejections - 35 USC §103(a)

A. In the non-final Office Action dated May 21, 2010, claims 1, 27, 28 and 30-33 are rejected under 35 USC §103(a) as being obvious over U.S. Patent Application Publication No. 2003/0062261 A1 of Shindo.

The Shindo '261 Application Publication

Shindo '261 discloses surface cleansing of a raw material hafnium sponge having a 2N (99%) purity level with fluoride nitrate for the sole purpose of eliminating "impurities attached to the surface thereof." See Paragraph No. 0120 of the Shindo '261 publication. After surface cleansing, the material is wrapped within Zn foil to obtain a compact which is placed within an electron beam furnace and subjected to electron beam melting. See Paragraph Nos. 0120-0121 of the Shindo '261 publication. After electron beam melting, the resulting material was cast to obtain an ingot. See Paragraph No. 0127 of the Shindo '261 publication. Thereafter, the ingot was placed within a hydrogen atmosphere furnace for producing hydrogenated hafnium powder. See Paragraph Nos. 0128-0129 of the Shindo '261 publication. Thereafter, the hydrogenated hafnium was heated in a vacuum or under an inert gas atmosphere to obtain hafnium powder. See Paragraph No. 0130 of the Shindo '261 publication. The powder can then be used to make a sputtering target directly from the powder via powder metallurgy techniques.

It is important to understand that surface cleansing with fluoride nitrate is limited to removing zirconium from only the surface of the hafnium raw material and not throughout the body of the material. (See page 1, lines 20-25, of the Declaration of Yuichiro Shindo Under 37 CFR §1.132 executed on June 24, 2009 of record in the present application having been previously submitted on July 31, 2009.) Also, electron beam melting is unable to remove Zr content form an Hf material because both elements are homologous elements and have very similar physical properties. (See page 1, lines 26-30, of the Declaration of Yuichiro Shindo Under 37 CFR §1.132 executed on June 24, 2009 of record in the present application having been previously submitted on July 31, 2009.)

Accordingly, the only removal of Zr from a hafnium material taught to one of ordinary skill in the art by the Shindo '261 publication is that zirconium on the surface of the material can be reduced via surface cleansing with fluoric acid. No other means for Zr content reduction from a hafnium material is disclosed by the Shindo '261 publication to one of ordinary skill in the art. Thus, whatever limits there are with respect to removing zirconium content with fluoric acid surface cleansing treatment of a hafnium material are the limits that one of ordinary skill in the art would understand at the time the present invention was made.

With respect to the purity of a hafnium material (excluding zirconium content and gas components), the disclosure provided by the Shindo '261 publication is limited to the following:

> "achieve a purity of 4N; that is, 99.99% (parts by weight)" [Paragraph No. 0012];

> "high purity hafnium of 4N (99.99%) can be manufactured" [Paragraph No. 0060]; and

> "high purity hafnium having a 4N (99.99%) level excluding zirconium and gas components such as oxygen and carbon was obtained thereby" [Paragraph Nos. 0090 & 0133].

Patentability Argument

In the Office Action, it is concluded that all claimed ranges recited in the claims of the present application are "overlapped" by that disclosed in the Shindo '261 publication. Applicant respectfully disagrees that the claim limitations are "overlapped" and respectfully requests careful and fair reconsideration.

As discussed above, the Shindo '261 publication is limited to a disclosure of a hafnium material "having a 4N (99.99%) level excluding zirconium and gas components". The Shindo '261 publication fails to disclose a greater level of purity beyond 4N (99.99%). The common sense reasoning for this is that the Shindo '261 publication is limited to disclosing purification techniques relying only on fluoric acid surface treatment and electron beam melting. One of ordinary skill in the art at the time the present invention was made would have recognized that there are limitations with these techniques and that purification beyond 4N (99.99%) would not be possible or expected, even if all processing steps of fluoric acid surface treatment and electron beam melting are optimized within the skills of one of ordinary skill in the art at the time of the invention.

Independent claim 1 of the present application requires a hafnium sputtering target or thin film having a purity of 4N5 (99.995%) to 6N (99.9999%). Independent claims 30 and 32 require a purity of at least 4N5 (99.995%) and dependent claims 28, 31 and 33 require a purity of 6N (99.9999%).

Applicant respectfully submits that the Shindo '261 publication fails to teach, suggest or disclose a hafnium material having a purity of 4N5 (99.995%) to 6N (99.9999%), a purity of at least 4N5 (99.995%), and a purity of 6N (99.9999%). For at least this reasons, Applicant

respectfully requests reconsideration and removal of the rejection of the claims based on the Shindo '261 publication.

Turning to the zirconium content limitations recited in the claims, independent claims 1, 30 and 32 each requires a zirconium content of 1 to 1000wtppm and new dependent claims 34 and 35 each requires a zirconium content limited to 1 to 200wtppm. No new matter was added; for example, see page 4, lines 30-31, of the present application, as filed. Also, see page 6, line 21, for a disclosure of an Example having 80wtppm of zirconium content and page 8, line 3, for a disclosure of an Example having 5wtppm of zirconium content.

In the Office Action, it is speculated that the Shindo '261 publication discloses an overlapping range of zirconium content. More specifically, Paragraph Nos. 0031, 0040, 0053, 0065 and claims 7, 15 and 26 of the Shindo '261 publication discloses a hafnium material having a content of Zr of "0.5% or less" (5,000wtppm or less). Here, the lower limit cannot be arbitrarily selected, such as 0ppm, 200ppm or 1,000ppm from the phrase "or less"; rather, U.S. patent law clearly requires the disclosure of the Shindo '261 publication to be considered as well as what the lower limit would actually be considered to be understood by one of ordinary skill in the art at the time the present invention was made. Thus, the lower limit provided by the "or less" phrase must be determined from the disclosure provided by the prior art reference and the level of understanding of one of ordinary skill in the art at the time the present invention was made. Any other basis would be an error.

Accordingly, Applicant respectfully submits that the disclosure of "0.5% or less" does not overlap the ranges recited in the claims of the present application when the teachings of the Shindo '261 publication are fairly considered and when that which would be considered to be a lower limit by one of ordinary skill in the art at the time of the present invention is considered. It

should be understood that prescribing a numerical range of Zr content within hafnium material is entirely different to prescribing a numerical range of easily changed parameters such as a treatment temperature, a treatment time or the like. One of ordinary skill in the art is certainly capable of changing or optimizing a temperature treatment or time; however, a difficult and unknown task of reducing Zr content from a hafnium material would not be within the skill of one of ordinary skill in the art. As evidence of this, see the following teaching provided by the Shindo '261 publication:

> " ... a large quantity of zirconium is contained in hafnium, and notwithstanding the fact that ***the separation and refinement between the two is difficult***, this may be disregarded since the purpose of use of the respective materials will not hinder overall purpose hereof" (see Paragraph No. 0061 of the '261 Shindo published application);
>
> and
>
> "***It is extremely difficult to reduce Zr in high purity hafnium*** ... the fact that Zr is mixed in high-purity hafnium will not aggravate the properties of semiconductors, and will not be a problem." (See Paragraph No. 0065 of the '261 Shindo published application).

Accordingly, Applicant respectfully submits that the numerical range of the Zr content should be limited to an **achievable range** based on the technical level of purification disclosed by the cited prior art reference to one of ordinary skill in the art. Here, it would not be obvious to one of ordinary skill in the art to "optimize" the range, because "separation and refinement between the two is difficult" and "It is extremely difficult to reduce Zr in high purity hafnium" as taught by the reference.

Applicant respectfully submits that when prescribing a numerical range to "or less", it is not possible to derive a range of 0 to 5000ppm, 200 to 5000ppm, or 1000 to 5000ppm from the Shindo '261 publication and its disclosure. When considering the Zr content that is achievable with the disclosure of the Shindo '261 publication, the Examples of the Shindo '261 publication

discloses a minimum Zr content of 2400ppm (Paragraph No. 0131, Table 4, page 8) and in combination with this disclosure, the Shindo '261 publication teaches to one of ordinary skill in the art that:

> " ... a large quantity of zirconium is contained in hafnium, and notwithstanding the fact that ***the separation and refinement between the two is difficult***, this may be disregarded since the purpose of use of the respective materials will not hinder overall purpose hereof" (see Paragraph No. 0061 of the '261 Shindo published application);
>
> and
>
> "***It is extremely difficult to reduce Zr in high purity hafnium*** ... the fact that Zr is mixed in high-purity hafnium will not aggravate the properties of semiconductors, and will not be a problem." (See Paragraph No. 0065 of the '261 Shindo published application).

Accordingly, the Shindo '261 publication does not expressly or inherently suggest to one of ordinary skill in the art that it is possible to reduce Zr content to below 2400ppm with the surface cleansing fluoric acid treatment and electron beam melting disclosed by the Shindo '261 publication. Accordingly, when considering the above disclosure, Applicant respectfully submits that there is no overlap between the 1 to 1000ppm or 1 to 200ppm zirconium content requirement of the claims of the present application with the "0.5% or less" disclosure provided by Shindo '261 publication because there is a clear understanding by one of ordinary skill in the art that the "or less" is limited to that expected to be achievable via use of surface cleansing fluoric acid treatment and electron beam melting purification techniques.

Accordingly, Applicant respectfully submits that a *prima facie* case of obviousness based on overlapping ranges cannot be made with the Shindo '261 publication. For at least this additional reason, Applicant respectfully requests reconsideration and removal of the rejection of the claims based on the Shindo '261 publication.

Further, Applicant respectfully submits that the present invention succeeded in reducing the Zr content in a hafnium material to a level that was not achievable by one of ordinary skill in the art following the teachings of the Shindo '261 publication at the time the present invention was made. Consequently, Applicant was able to realize a stable permittivity in a state-of-the-art fine gate insulation film formed using the high-purity hafnium sputtering target of the present invention. In addition, Applicant was able to realize the mass production of semiconductor devices comprising these favorable characteristics. Accordingly, the hafnium material having Zr content of 1 to 1000wtppm according to the present invention is able to yield an effect that was unexpected in the past and that achieved commercial success. (If the Examiner determines that it would be of any assistance in issuing allowance of the present application, Applicant is willing to prepare and submit a sworn declaration concerning the statements made in this paragraph.)

Finally, with respect to independent claim 30 of the present application which is directed to a sputtering target, it has been amended to require the sputtering target body to have a forged and rolled microstructure having been subject to forging and rolling processing. No new matter was added. For example, see page 5, lines 22-23, with respect to manufacturing a target using rolling and forging processes. Accordingly, the target body would be a body subject to plastic working and would thus inherently have a microstructure that reflects the plastic working. In contrast, the Shindo '261 publication discloses a hafnium material that is subject to surface cleansing and electron beam melting and then processed into a powder. Thus, it is the powder that is ultimately used and pressed together to form the sputtering target. Forging, rolling and other techniques are not disclosed. Accordingly, Applicant respectfully submits that claim 30 is patentable over the Shindo '261 publication for this additional reason.

Accordingly, Applicant respectfully submits that the claims of the present application are unobvious and patentable over the teachings of the cited reference. Applicant respectfully requests reconsideration and removal of the above referenced rejection of claims 1, 28 and 30-33 of the present application.

B. *In the non-final Office Action dated May 21, 2010, claims 1, 27, 28 and 30-33 are rejected under 35 USC §103(a) as being obvious over the publication in the ASM Handbook of Murray titled "Preparation and Characterization of Pure Metals".*

Murray, page 1094, provides the following disclosure:

> "In purification by chemical vapor deposition (CVD), the starting material is reacted to form a gaseous compound, and that compound is subsequently decomposed in the vapor state. The metal vapor then is condensed to form a solid higher in purity than the starting material.
>
> One of the more popular of the chemical vapor deposition processes is the iodide process, which has been used extensively to purify titanium, zirconium, and chromium (Ref 5). For each of these metals, the starting charge of metal is reacted to form a volatile metal iodide compound, which in turn is thermally decomposed to liberate iodine vapor. The pure metal is allowed to condense onto a suitable heated substrate (glass tubes and wires of the base metal have been used), while the iodine returns to the metal charge to form more iodide compound. Hence, the iodine acts as a carrier of the metal from the charge to the substrate."

Murray teaches that impurity metals can be carried over in the CVD method since some impurity metals are similar in terms of the reactivity with the iodine as that of the metals to be purified. For example, Murray highlights a "low-iron starting metal" because Fe is carried over with the metals being purified when the metals to be purified are specifically selected from Ti, Zr and Cr.

Thus, while a low-iron starting metal may be important in the purification of some metals, this is not true of all metals. Accordingly, where Murray states "if a low starting metal is used,

the condensed vapor will approach a purity level of 99.999%", this is in specific reference to Ti, Zr and Cr, and not every metal.

Accordingly, the expression "in all cases" on page 1094, column 3, line 14, of Murray refers to the "cases" of purifying Ti, Zr and Cr described in the paragraph, not all metals. In addition, reference to the "starting metal" on page 1094, column 3, lines 14 and 19, in Murray refers to the specific starting metals of Ti, Zr and Cr described in the same paragraph. Further, the expressions "these metals" on line 18 and "only iron is carried over with these metals" on lines 17-18, refers to Ti, Zr and Cr described in the same paragraph. At this point in the description of Murray, purifying hafnium is not yet disclosed.

Moreover, in the test results of Zr, Cr and Ti in Murray, there is a description stating that "if a proper temperature is maintained, oxygen, nitrogen, hydrogen, and carbon, as well as many metallic impurities will not be carried over." However, this statement is merely an assumption based on the facts that were demonstrated with Zr, Cr and Ti and may not be applicable to all metals.

Applicant respectfully submits that there is no legitimate teaching by Murray to one of ordinary skill of the art of how to realize a purity level of 4N5 (99.995%) or 6N (99.9999%) for a hafnium material. In fact, Murray fails to teach what level of purification can be obtained for hafnium. Murray merely states that "other metals have been purified by chemical vapor deposition" and lists hafnium among many other metals. The extent to which these "other metals" can be purified is not disclosed, and it would be a mistake to simply assume the same results achievable for Zr, Cr and Ti would necessarily be achievable for the "other metals".

Thus, Applicant respectfully submits that Murray fails to disclose a hafnium material of 5N (99.999%) purity. In addition, there is clearly no overlap with that required by the claims of the present application.

From a scientific standpoint, similar to the acid surface cleansing and electron beam melting of the '261 Shindo publication, the "iodide process" referred to by Murray is a method of separation relying on the difference of chemical behavior between Hf and impurities. As stated in the '261 Shindo publication, it is extremely difficult to separate elements, such as Zr from Hf, which have similar chemical properties. Thus, the iodide process disclosed by Murray would be expected by one of ordinary skill in the art to be ineffective at reducing Zr content which exists in an Hf material to any great extent, and certainly not down to 1000wtppm or 200wtppm. One of ordinary skill in the art would clearly expect the Zr content to remain about the same in the iodide processed Hf material as that of the Hf raw material. Thus, one of ordinary skill in the art would expect the iodide process to have virtually no effect in separating Zr from an Hf material considering their similar chemical properties.

For all the reasons stated above, Applicant respectfully submits that claims 1, 27 and 30-33 of the present application are not obvious in view of the ASM Handbook. Applicant respectfully requests reconsideration and removal of the rejection.

II. Conclusion

In view of the above amendments and remarks, Applicant respectfully submits that the claim rejections have been overcome and that the present application is in condition for allowance. Thus, a favorable action on the merits is therefore requested.

Please charge any deficiency or credit any overpayment for entering this Amendment to our deposit account no. 08-3040.

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